

WHAT IS CLAIMED IS:

1. An optics/controller sub-assembly for automated focus and brightness control in a spatial light modulator projection system, comprising:

5 a lamp/reflector providing white light along a first light path, said light brought to a focus point at the entrance to a light integrator;
a first relay lens receiving light from said light integrator and sizing said light to the
10 entrance of a second group of relay lenses;
light from said relay lenses continuing along said first light path, striking the surface of a partial folding mirror;
primary light reflecting off said partial
15 folding mirror along a second light path and partial light passing through said partial folding mirror exiting along a third light path;
a third relay lens placed in said second light
20 path, receiving said reflected primary light from said partial folding mirror and resizing said light to match said system's total internal reflective prism;

light passing through said total internal
reflective prism to red-green-blue splitting
prisms;

spatial light modulators positioned to receive
5 said red-green-blue light, respectively, from
said color prisms, said light being modulated
and reflected from said respective spatial
light modulators into recombining optics,
through a projection lens, and on to a display
10 screen;

a third relay lens located in said third light
path, receiving said partial light passing
through said partial folding mirror, sizing, and
directing said light on to the surface of
15 secondary folding mirror;

a light detector receiving said reflected light
from said secondary folding mirror, a micro-
controller coupled to the output of said
20 detector;

first, second, and third outputs from said
micro-controller coupled to lamp x, y, z focus
servomotors, respectively;
a fourth output from said micro-controller
coupled to a lamp power supply; and

a fifth output from said micro-controller to enable a maintenance notification function.

2. The optics/controller sub-assembly of Claim 1,
wherein said partial folding mirror performs a
5 sampling filter function on light along said first
light path, allowing a fraction of less than 1% of
said light to pass through said folding mirror.
3. The optics/controller sub-assembly of Claim 2
wherein said light along third light path is focused
10 to form an image, having a fraction of the light of
said projected display image, on the surface of said
detector.
4. The optics/controller sub-assembly of Claim 3
wherein said fraction of light focused on said
15 detector has the same light distribution as said
projected light focused on said display screen.
5. The optics/controller sub-assembly of Claim 3,
wherein the brightness of said fraction of light
focused on said detector correlates with the overall
20 brightness of said projected light focused on said
display screen.
6. The optics/controller sub-assembly of Claim 1,
wherein said servomotors adjust the lamp position to
maintain optimum real-time light distribution in
25 said projection system.

7. The optics/controller of Claim 1, wherein said lamp power supply is adjusted to maintain maximum brightness level during warm-up of said projection system.
- 5 8. The optics/controller of Claim 1, wherein said maintenance notification alerts personnel to service said projection system, replacing said lamp if necessary.
9. A screen/controller sub-assembly for automated focus and brightness control in a spatial light modulator projection, comprising:
- 10 a projection display screen having an array of light detectors for measuring the total brightness and light distribution of a projected image;
- 15 a micro-controller coupled to the detectors of said sensor array;
- x, y, and z axis servomotors coupled to respective outputs from said micro-controller for positioning said projector's lamp;
- 20 a brightness control output from said micro-controller coupled to a lamp power supply; and a maintenance notification output from said micro-controller.

10. The screen/controller sub-assembly of Claim 9,
wherein said servomotors are used to maintain
optimum real-time light distribution across said
display screen in said projection system.
- 5 11. The screen/controller sub-assembly of Claim 9,
wherein a lamp power supply is adjusted to maintain
a uniform brightness level during warm-up of said
projection system.
12. The screen/controller sub-assembly of Claim 9,
10 wherein said maintenance notification alerts
personnel to service said projection system,
replacing said lamp if necessary.
13. An automated lamp focus method for spatial light
modulator based projection systems, comprising the
15 steps of:
- focusing an image, using a small fraction of
the system's projected light, on to a detector
located in said system's optics chain;
obtaining sensor data at the input of a micro-
20 controller;
- calculating the lamp luminance distribution and
determining if said distribution is within
specification, and if said distribution is out
of specification, providing input signals from

said micro-controller to x, y, and z
servomotors to adjust the lamp focus;
if said luminance distribution is within
specification or after x, y, z focus

5 adjustments have been made, then determining if
luminance brightness level is within
specification, if said brightness level is out
of specification, adjusting a lamp power supply
to bring said brightness level into
10 specification;

if said brightness cannot be adjusted within
specification, notifying maintenance personnel
to replace said lamp; and
if said luminance level is within specification
15 or after said maintenance service is complete,
obtaining new sensor data and repeating
procedure.

14. The method of Claim 13, wherein said servomotor
adjusts said lamp position to maintain optimum real-
20 time light distribution in said projection system.

15. The method of Claim 13, wherein said lamp power
supply is adjusted to maintain a uniform brightness
level during warm-up of said projection system.

16. An automated lamp focus method for spatial light modulator based projection systems, comprising the steps of:

5 reading data from an array of sensors embedded in the surface of a display screen into a micro-controller;

calculating the lamp luminance distribution across said screen and determining if said distribution is within specification, and

10 if said distribution is out of specification, provide input signals from said micro-controller to x, y, and z servomotors to adjust the lamp focus;

if said luminance distribution is within

15 specification or after x, y, z focus adjustments have been made, then determine if luminance brightness level is within specification;

if said brightness level is out of

20 specification, adjusting a lamp power supply to bring said brightness level into specification;

if said brightness cannot be adjusted within specification, notifying maintenance personnel to replace said lamp; and

if said luminance level is within specification
or after said maintenance notification is made,
obtaining new sensor data and repeating
procedure.

- 5 17. The method of Claim 16, wherein said servomotors are
used to adjust said lamp position to maintain
optimum real-time light distribution in said
projection system.
18. The method of Claim 16, wherein said lamp power
10 supply is adjusted to maintain a uniform brightness
level during warm-up of said projection system.
19. A spatial light modulator based electronic
projection system with automated lamp focus control,
comprising:
- 15 a light source consisting of a reflector and
lamp, emitting light along a first light path;
a first optional turning mirror to direct light
from said light source to focus at the input of
a light integrator;
- 20 a first relay lens and a second optional
turning mirror for directing light from the
output of said integrator to a second series of
relay lenses and on to the surface of a partial
turning mirror;

primary light reflected from said partial
turning mirror directed along a second light
path through a third relay lens and through a
total internal reflective prism on to the
5 surface of red-green-blue color splitting
prisms, respectively;

three spatial light modulators positioned to
receive red-green-blue light, respectively,
from said color prisms;

10 modulated light reflected from said spatial
light modulators directed through recombining
optics and projected by means of a projection
lens, on to a display screen;

secondary light passing through said partial
15 turning mirror directed along a third light
path, through a focusing lens and reflecting
off a secondary turning mirror on to the
surface of a light detector, wherein the output
of said light detector is used to control the
20 brightness and light distribution of said light
source.

20. The apparatus of Claim 19, further comprising:

a micro-controller coupled to the output of
said light detector;

first, second, and third outputs from said lamp focus mechanism driving respective x, y, and z servomotors for precisely positioning said lamp;

5 a fourth output from said lamp brightness control circuitry driving a lamp power supply for adjusting said lamp's brightness; and a fifth output of said micro-controller providing a maintenance notification signal.

10 21. The apparatus of Claim 20, wherein said servomotors are used to adjust said lamp position to maintain optimum real-time light distribution in said projection system.

22. The apparatus of Claim 20, wherein said lamp power
15 supply is adjusted to maintain a uniform brightness level during warm-up of said projection system.

23. The apparatus of Claim 20, wherein said maintenance notification alerts personnel to service said
20 projection system and replace said lamp if necessary.

24. A retrofit automated lamp focus and brightness control assembly for spatial light modulator based projection systems, comprising:

a partial turning mirror to replace an existing
25 turning mirror in said projection system's

optical path, said partial turning mirror
allowing a small fraction of the system's
projected light to pass through it;
a focusing lens receiving said fraction of
5 light from said partial turning mirror, said
light passing through said focusing lens and
reflecting off a secondary turning mirror on to
the surface of a light detector, wherein the
output of said light detector is used to
10 control the brightness and light distribution
of said light source.

25. The apparatus of Claim 24, further comprising:
a micro-controller coupled to the output of
said light detector;
15 first, second, and third outputs from said lamp
focus mechanism driving respective x, y, and z
servomotors for precisely positioning said
lamp;
a fourth output from said lamp brightness
20 control circuitry driving a lamp power supply
for adjusting said lamp's brightness; and
a fifth output of said micro-controller
providing a maintenance notification signal.

26. The apparatus of Claim 25, wherein said servomotors
25 are used to adjust said lamp position to maintain

optimum real-time light distribution in said projection system.

27. The apparatus of Claim 25, wherein a lamp power supply is adjusted to maintain a uniform brightness level during warm-up of said projection system.

28. The apparatus of Claim 25, wherein said maintenance notification alerts personnel to service said projection system and replace said lamp if necessary.

29. A spatial light modulator based electronic projection system with automated lamp focus control, comprising:

a light source consisting of a reflector and

lamp, emitting light along a first light path;

a first optional turning mirror to direct light from said light source to focus at the input of a light integrator;

a first relay lens and a second optional

turning mirror for directing light from the

output of said integrator to a second series of relay lenses and on to the surface of a partial turning mirror;

primary light reflected from said partial

turning mirror directed along a second light

path through a third relay lens and through a

total internal reflective prism on to the surface of red-green-blue color splitting prisms, respectively;

three spatial light modulators positioned to receive red-green-blue light, respectively, from said color prisms;

modulated light reflected from said spatial light modulators directed through recombining optics and projected by means of a projection lens, on to a display screen; and

an array of light sensors located on the surface of said display screen for measuring total brightness and light distribution of the projected image.

15 30. The apparatus of Claim 29, wherein said array of sensors are embedded in selected perforations in the surface of said display screen.

31. The apparatus of Claim 30, further comprising:

a micro-controller coupled to the output of said light detector;

first, second, and third outputs from said lamp focus mechanism driving respective x, y, and z servomotors for precisely positioning said lamp;

a fourth output from said lamp brightness control circuitry driving a lamp power supply for adjusting said lamp's brightness; and a fifth output of said micro-controller providing a maintenance notification signal.

32. The apparatus of Claim 31, wherein said servomotors are used to adjust said lamp position to maintain optimum real-time light distribution in said projection system.

10 33. The apparatus of Claim 31, wherein said lamp power supply is adjusted to maintain a uniform brightness level during warm-up of said projection system.

34. The apparatus of Claim 31, wherein said maintenance notification alerts personnel to service said projection system and replace said lamp if necessary.

15 35. An automated focus and brightness control system comprising:

20 a lamp providing white light along a first light path;
servos positioning said lamp;
a partial mirror on said first path, said partial mirror separating said white light into a primary beam and a secondary beam;

a display engine for producing an image using
said primary beam and projecting said image to an
image plane;

5 a detector receiving said secondary beam, said
detector providing a signal indicative of a
brightness and focus of said lamp;

a controller receiving said signal and
controlling said servos to focus said lamp.

36. An automated focus and brightness control system
10 comprising:

a lamp providing white light along a first
light path;

servos positioning said lamp;

15 a display engine for producing an image using
said white light and projecting said image to a
screen;

a detector embedded in portions of said screen
for measuring a brightness and uniformity of said
image, said detector providing a signal indicative
20 of a brightness and uniformity of said lamp;

a controller receiving said signal and
controlling said servos to focus said lamp.